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Focus on Friends

Ludlow Tuart Forest Restoration Group

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www.ludlowtuartforest.org.au

Summary

The Ludlow Tuart Forest Restoration Group (LTFRG) was established in 2018. We are a community group of volunteers who are facilitating support for the restoration, protection and maintenance of the Ludlow tuart forest, located between Busselton and Bunbury, south of Perth. The tuart forest tenure includes National Park, State Forest and the heritage listed Ludlow Forest Settlement. Early LTFRG achievements include the planting of over 75,000 tuart seedlings into state forest sites previously cleared for agricultural pursuits. The signing of a long-term lease ensures the protection and conservation of the heritage Ludlow Forest Settlement buildings and infrastructure. LTFRG have recently completed the Ludlow Master Plan providing direction for future heritage retention, development, tourism, employment and conservation. Income generated by this forest based multi-purpose venture will be invested in the continued restoration and maintenance of the adjoining tuart forest and the Ludlow Settlement heritage site and buildings.

Introduction

When people drive from Perth and Margaret River most do not realise that this area was once occupied by magnificent tuart trees (*Eucalyptus gomphocephala*) (Fig. 1). The tuart forest covered a coastal strip of 110,000 ha on the Swan Coastal Plain, from the Sabina River near Busselton to north of Perth. Only 3% remains today with the most extensive area being 1,925 ha within the local government areas of City of Busselton and Shire of Capel. The historic Ludlow Settlement is central to the area and straddles the Ludlow River (Fig. 2).

History of the tuart forest and Ludlow Settlement

This now remnant forest has a troubled, recent 190-year history following European settlement. Figure 1 and its caption accurately describe the majestic tuarts in their natural state.

In the first 100 years of European settlement the tuart forest was exploited for cattle grazing and clearing for agriculture. Tuart timber

Figure 1. 'Here we have a splendid view of a more than typical portion of the tuart forest which are only found in a comparitivly narrow strip of calcareous country which lies along our coastline from Busselton to several miles north of Perth. Although the site of this view is so neat and park like it is true to nature and has not been improved artificially in any way.' Ednie-Brown F.L.S. F.R.H.S. (1896, p. 56). Photograph taken while camped at Lockville on 10 and 11 November 1896, reproduced with permission.

was recognised for its durability and resistance to abrasion; it was used for housing, fencing, hardwearing applications and fuel. In these early days timber harvesting throughout the state's native forests was not constrained by government regulation; this commercial exploitation was very important for the development of Western Australia, with most timber

Figure 2. Location of the Ludlow Settlement.

being exported that support the developing economy.

In the 1890s Mr. J. Edney-Brown was appointed by the Woods & Forest Department (part of the Lands Department) to take charge of timber harvesting, but his untimely death left this position vacant for many more years. In 1910 Charles Lane-Poole was appointed by the state government to introduce harvesting control and forest management. He was appointed Conservator of Forests in 1916 and wrote the Forests Act and regulations which were passed into law by government in 1918. The headquarters of the Forests Department was at Ludlow. A Forestry School was established there in 1921 where field staff were taught forest husbandry skills and techniques (Fig. 3). From the 1920s onwards Ludlow was also the centre of research into the introduction and establishment of softwood species (pines) and many of the resulting trial plantations are still evident in the area.

The Forests Department became a major employer in the southwest, and its headquarters moved from Ludlow to Perth. The Forestry School closed in 1927, and after various uses was destroyed by fire in 1979. In the 1940s a new sawmill was constructed at Ludlow to process tuart from the adjacent forest and later pines from the nearby plantations. This sawmill closed in the mid-1970s and is still extant (Heritage Council of Western Australia 2006).

The Ludlow-Wonnerup Area was entered on the Register of the National Estate in 1978. Whilst the focus of this registration was on the natural stands of tuart, the Ludlow Settlement was recognised as having special significance for the history of forestry in Western Australia. The Tuart Forest National Park was declared in 1987 and the Ludlow Forestry Mill and Settlement were heritage-listed (Heritage place number 15834) in 2006.

In 2014 the Conservation Commission of Western Australia prepared a Tuart Forest National Park management plan which emphasises

Figure 3. The Ludlow forestry school 1923. Photo: George Clover collection. Sourced from the collections of the State Library of Western Australia and reproduced with the permission of the Library Board of Western Australia reproduced with permission.

the value of the tuart forest and how the long-term conservation of tuart can be managed (Department of Parks and Wildlife 2014). Amongst other things, this national park includes vegetation types characterised by the presence of tuart, internationally significant Ramsar-listed wetlands, Noongar (Wardandi) cultural heritage sites of mythological, archaeological and spiritual significance, and the historic Ludlow Forestry Settlement.

Ludlow Tuart Forest Restoration Group

The Tuart Forest National Park management plan is an ambitious document with desired outcomes, management actions and key performance indicators, many of which have reporting requirements every 5 years. There is no mention, however, of the budget required to achieve these aims.

The LTFRG, formed in 2018, is a group of volunteers who are assisting with some of the aims and objectives of the management plan. In particular the LTFRG are engaged in the restoration of state forest areas adjacent to Ludlow, together with the restoration of the heritage Ludlow Settlement buildings.

The objective of the LTFRG is [www.ludlowtuartforest.org.au/strategic-plan/] is:

To provide community support for the essential restoration, protection and ongoing maintenance of the iconic Ludlow tuart forest and the historic Ludlow Forestry Settlement for the benefit of future generations, biodiversity, tourism, education and research.

Values are:

- Encourage community involvement and ownership in all restoration projects.
- Respect past indigenous care for country and encourage future participation.
- Develop assets to provide for tourism, recreation, education, and employment.

Goals in relation to the tall tuart forest are:

- Restore within 45 years, the tall tuart forest canopy to provide for eco system dependent biodiversity to be returned. Conservation.
- Manage current threats, Human, animal, plant, insect and pathogen. Forest protection.
- Provide facilities to support, protect, breed and reintroduce dependent biodiversity, jobs and growth.
- Develop multifaceted tourism with links to estuary and RAMSAR listed wetlands bird sanctuary.

Goals in relation to the Ludlow Forestry Settlement are:

- Secure lease, restore power, water, security, communications and access.
- Provide a welcoming, safe, tuart forest-based education resource centre.
- Restore all buildings and infrastructure to reflect heritage and history.
- Repurpose internal spaces to allow commercial opportunity and employment.
- Provide for informative, physical, recreational tourism entry into the tuart forest.
- Renovate cottages to provide managed onsite amenity, camping and security.
- Establish opportunities to support commercial activity and employment.
- Provide resources, space and opportunity for aboriginal heritage, public education in traditions, arts, crafts, displays, commercial sales and employment.

This is an ambitious programme covering both the natural and built environment. To date LTFRG have obtained limited small funding grants and in-kind support from Federal and State Governments, local government, corporations, local businesses and individuals.

Achievements to date – the natural environment

The LTFRG aims to recreate a tuart forest ecosystem of not just the trees, but also the understorey plants and dependent biodiversity. There is no straight-forward recipe for this because tuart has often been difficult to re-establish on sites where it had once grown.

Funding in the form of individual and corporate tree sponsorship together with Federal Government and State Government small grants have been used to restore degraded lands on both sides of the Ludlow River. It has also been used to restore degraded areas where tuart once grew, but were cleared for agriculture. This land was repurchased by concerned government 100 years ago and leased back to farmers to continue cattle grazing during the desperate years of two world wars and the Great Depression. The cleared areas were planted to

pines in the late 1950s and 60s. The final harvesting of the pines in Lochart block was completed 20 years ago. It is this land provided by Department of Biodiversity Conservation and Attractions (DBCA) that was prepared and planted back to tuart by LTFRG volunteers and school children over the past 3 years. (Figs 4, 5). In this case the revegetation has been very successful, but there is much to learn about how to re-create a forest with its associated benefits of carbon capture, tourism, recreation, education, heritage, clean air and water management. A small area fenced by the Capel Land Conservation District Committee (LCDC) has shown the recovery of many of the native understorey species of the tuart forest following arum lily and herbivore control on the site (Fig. 6).

Figure 4. School children replanting tuart in 2019. Photo: Janet Wells.

Figure 5. 18 month old tuarts, hand planted, Central block in 2021. Photo: Des Donnelly.

Figure 6. This 10 ha area was fenced by the Capel LCDC to exclude herbivores, together with arum lily control. The area is predominantly scattered tuart over banksia woodland located within the Minninup forest block. The native plant understory visibly displays the conservation success. Photo: Des Donnelly

Achievements to date – the heritage buildings

The Ludlow Forestry Mill and Settlement contains industrial and residential buildings erected by the Forests Department which were common in the southwest. Some of the buildings were constructed in the 1920s, but most of the cottages, sawmill, workshop and associated buildings were constructed in the 1950s and 1960s. There are no other comparable intact sites in Western Australia (Heritage Council of Western Australia 2006).

Funding from local government and donors has been used to clear away accumulated rubbish, secure the site, make the buildings safe and provide on-site security. This work has been achieved by the management committee, community volunteer busy bees and with considerable help from Department of Corrections, Bunbury, Section 95 work release parolees. All of this work is highly valued and a credit to all involved. An example of what has been accomplished is given below (Figs 7, 8). Some work, however, can only be done by approved tradespeople working to exacting heritage rules. There are also numerous statutory regulations that must be met resulting in considerable cost in both funding and time. Should volunteers be expected to fund these imposed costs to meet complex regulations?

Planning for a self-sufficient heritage/ tourism site

This restoration project needs secure, on-going funding to fully restore the Ludlow site. The LTFRG have developed a Master Plan to guide restoration and development. The group has successfully negotiated a 20 year lease for the settlement area with DBCA. This agreement allows for investment to develop a tuart forest

Figure 7. Truck bay shed before restoration. The asbestos roof has been removed, and some timber structural members and weather boards replaced. Photo: Des Donnelly.

resource and education centre, short stay accommodation facilities, café, and function centre. Future plans also include the repurposing of existing buildings, native plant nursery and arboretum and provision of a children's nature playground and walking trails.

The LTFRG (Fig. 9) have achieved a huge amount in the past 4 years, and they have had fun along the way. Clear objectives for the protection and maintenance of the Ludlow tuart forest and the historic Ludlow Forest Settlement are in place, together with a clear vision of how these objectives can be further developed for the benefit of future generations and dependent forest biodiversity.

Thank you to our volunteers

The LTFRG volunteers and management team, together with the remnant threatened tuart forest biosphere and the heritage declared Ludlow Forest Settlement offer the following:

"Sincere thank you for your achievements to date".

To all of our 620 financial members, our generous sponsors, community volunteers, in-kind supporters, section 95 parolees and supportive local and responsible state and local government agencies, we thank you for your concern, support and positive

Figure 8. Truck bay shed after restoration. The building has been straightened up, a new 285 m^2 zinc alum roof fitted together with a 110,000 L rainwater tank which provides potable water to the Ludlow Settlement. This work was carried out by Department of Corrections, Bunbury, Section 95 work release parolees, and the Ludlow Tuart Forest Restoration Group community volunteers. The project was funded by a City of Busselton community grant of $19,000. Photo: Des Donnelly.

Figure 9. The Ludlow Tuart Forest Restoration Group raring to go on a busy bee. Like minded volunteer community members are needed now more than ever. To become a welcome member visit our web page to register on line. www.ludlowtuartforest.org.au Photo: Des Donnelly.

involvement. To the over 400 school children, their teachers and schools; thank you for your brilliant tuart seedling planting efforts. You will all be able to follow the future development of the renewed forest you have helped to recreate.

This recovery will take time. It is now up to us, on behalf of future generations, to accept full responsibility for forest ecosystem management for all values and expect elected governments to fully fund the restoration and silvicultural treatments which are crucially important for the health, vigour, conservation and protection of these now threatened, critically important, unique ecosystems. We urge interested parties to become involved and support LTFRG in practical forest and heritage restoration values.

Acknowledgements

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A significant southerly range extension of *Ctenotus angusticeps* (Lacertilia: Scincidae) from Exmouth Gulf

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Abstract

The distributions of many Australian reptiles remain uncertain due to a lack of systematic or targeted fauna surveys. The documented distributions in the literature are largely based on institutional collection records, while photographic or field observations may not be formally recorded. Therefore, it is important to contribute previously unrecorded information on the distributions of herpetofauna in the scientific literature. Here we present a significant range extension of *Ctenotus angusticeps* from Exmouth Gulf, Western Australia (WA). This small skink has a very fragmented distribution on the mainland due to its habitat specificity of primarily salt marsh communities adjacent to mangroves where it shelters in crab holes. We also comment on the conservation status of this species suggesting the current listing of Least Concern is inadequate.

Introduction

Range extensions are regularly recorded in Australian reptiles and could be considered unsurprising, particularly in remote and often poorly surveyed regions. For example, range extensions have been documented for large iconic species such as Perentie *Varanus giganteus* and Black-headed Python *Aspidites melanocephalus* (Thompson *et al*. 2005; Ellis & Hearle 2015), and even in well-surveyed areas of southwestern WA, the local distributions of some reptiles can remain uncertain (Algaba 2005; Davis & Bamford 2005; Maryan & Algaba 2011; Maryan *et al*. 2015).

Combining improved conventional trapping techniques used today during systematic fauna surveys with opportunistic collecting by field herpetologists can result in large and diverse species lists however, the use of these techniques does not guarantee a complete inventory. For example, some small fossorial species (e.g. genera *Aprasia* and *Lerista*) often show high site fidelity and/or low vagility, and can go undetected if a particular habitat is not appropriately surveyed, the trapping program is of short duration, a certain trap type is not used to sample the various reptile groups or even when no active foraging is done (How & Shine 1999; Maryan & Bush 2007; Thompson & Thompson 2007; Maryan & Turpin 2012; B. Maryan & G. Gaikhorst, pers. obs.).

Glen Storr and other contemporary contributing colleagues greatly

enhanced our knowledge and understanding of the WA coastal herpetofauna with the publication of a series of detailed inventories in which the biogeographical relationships and habitat preferences were documented (Storr & Harold 1978, 1980, 1984, 1985, 1990; Storr *et al.* 1981, 1983). One of these herpetofaunal assessments covered the Exmouth region, recording 114 species, including the marine turtles and snakes (Storr & Hanlon 1980). The total falls to 89 species when only the terrestrial herpetofauna on the North West Cape based upon museum collection records are considered (Kendrick 1993). An updated terrestrial reptile species list, largely adapted from Kendrick (1993), integrating taxonomic studies, biological databases and including a range extension of *Proablepharus reginae* listed 90 species (Beranek *et al.* 2021). A further three species bring the total number to 93 when the geckos *Crenadactylus occidentalis* (in addition to *C. tuberculatus* [Doughty *et al.* 2016]), *Gehyra gemina* (introduced, reported as *Gehyra australis* [Maryan 2009]) and a snake *Neelaps bimaculatus* (Maryan 1995) are included. Following this trend of adding species, we record for the first time *C. angusticeps* from Exmouth Gulf.

Observation

When described by Storr (1988), *Ctenotus angusticeps* was originally thought to be restricted to a single island off the Pilbara coast (Airlie Island), until it was later discovered on the mainland at two widespread localities (Sadlier 1993; Turpin & Ford 2011). A broader geographic survey initiated by BHP Billiton Limited, resulted in several new location records as well as information provided on genetic variation, habitat preferences and other observations (Maryan *et al.* 2013). The Exmouth Gulf is a large area with international conservation significance and extensive 'salt marsh communities', the specific habitat broadly described by Maryan *et al.* (2013) for *C. angusticeps*. This habitat consists of a landward fringe of salt marsh communities, vegetated with samphire and marine couch grass immediately adjacent to or a short distance from mangroves, although still in close association. The dominant vegetation consists of the succulent samphires *Tecticornia* spp. and *Suaeda arbusculoides* on clayey soils with a mixed herb and grass cover of *Muellerolimon salicorniaceum* and *Sporobolus virginicus* on sandy soils (Beard 1990).

With this habitat specificity in mind, we searched at two localities, ~18 and 19 km northeast of Bullara Homestead (-22.531439°S, 114.109947°E) by slowly walking through areas of salt marsh communities considered suitable in August 2021. At least 15 individuals of active *C. angusticeps* were observed. We managed to capture a single skink by hand under a piece of coral debris which we photographed (Fig. 1), measured (49 mm SVL, 104 mm tail) and took a tissue sample (tail-tip) that was lodged at the WA Museum (WAM TR2133). Due to an abundance of crab holes, most of the skinks retreated down them when approached after initially remaining active at the base of low vegetation. A description of *C. angusticeps* at this new location conformed in colour and pattern to that provided by Maryan *et al.* (2013) being a faintly mottled pattern consisting of short whitish to cream flecks or bars intermixed with darker markings that

Figure 1. *Ctenotus angusticeps* from Exmouth Gulf. Photo: B. Maryan.

tended to align longitudinally on the dorsal surface to form a vertebral stripe often extending along the tail, on a pale brown ground colour (Fig. 1). The habitat is similar to that previously described by Maryan *et al.* (2013) with very open *Tecticornia* spp. over mixed low samphire species; although one location contained denser vegetation, interspersed with low sandy rises with scattered *Sporobolus virginicus*. Both locations were adjacent to tidal creeks lined with mangroves on a flat terrain with sandy clay substrate, copious shell-grit and coral debris (Fig. 2). While searching, other lizard species observed were the dragons *Ctenophorus isolepis isolepis* and *Lophognathus horneri* and the skinks *Ctenotus rufescens* and *Menetia greyii*.

Discussion

Ctenotus angusticeps represents an additional species to the highly diverse and conservation significant North West Cape (Kendrick 1993; Beranek *et al*. 2021). This record substantially increases the southerly mainland distribution of this species by ~350 km linear distance from Lulu Creek at ~7 km east of Karratha (Maryan *et al.* 2013), although the Airlie Island population is much closer at ~190 km (Fig. 3). We suspect that searches in suitable habitat between Exmouth Gulf and Karratha will reveal additional populations, though there is limited access in this area with extensive tidal flats adjacent to the coast.

The conservation status of *C. angusticeps* was previously listed as Vulnerable by both state and federal legislation, but due to the additional information on its much wider distribution, it has since been downgraded to a Priority 3: poorly known species in WA, of which the criteria states 'species that are known from several locations, and the species does not appear to be under imminent threat, or from few

Figure 2. The habitat at Exmouth Gulf where *C. angusticeps* was observed. Photo: B. Maryan.

but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat' (Department of Biodiversity, Conservation and Attractions 2019). Similarly, *C. angusticeps* is considered to be Least Concern under the IUCN conservation status, based on the broad justification of 'although it has a relatively restricted range, there are no major threats and the population is unlikely to be substantially declining' (Chapple *et al.* 2019). However, it still remains listed as Vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The downgraded categories of *C. angusticeps* to Priority 3 and Least Concern are largely based on rationale that allows a species to be considered Secure with very limited knowledge. *Ctenotus angusticeps* now shares the same IUCN Least Concern categorisation with two of Australia's most common and widespread lizards, the gecko *Heteronotia binoei* and skink *Menetia greyii* (Chapple *et al.* 2019). Despite the additional information provided by Maryan *et al.* (2013), we still do not know important information such as population size and structure, ecology, threats and threat amelioration. Our understanding of the relationship between this lizard and its environment, particularly an apparent dependency on crab holes for shelter, and its responses to change in the environment is unknown, so we

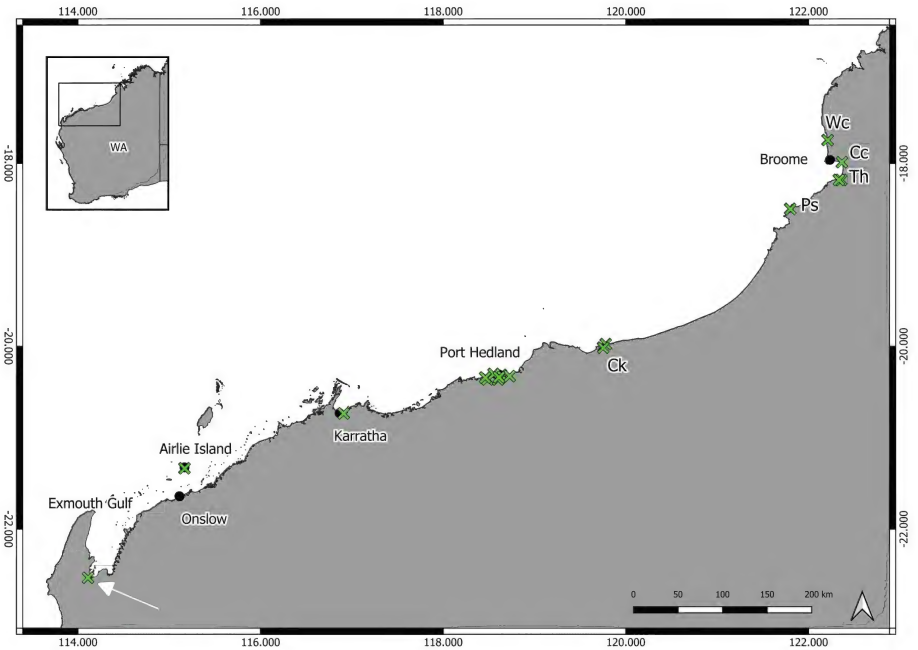

Figure 3. Updated distribution map for *Ctenotus angusticeps* indicated by green crosses and arrow pointing to new record at Exmouth Gulf. Abbreviations: Ck Cape Keraudren, Ps Port Smith, Th Thangoo, Cc Crab Creek, Wc Willie Creek.

suggest an amendment in the IUCN conservation status to Data Deficient, of which the criteria states 'species when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population' (International Union for Conservation of Nature 2021). We provide some discussion points in relation to this deficiency below.

- Owing to its fragmented distribution along the coast, all known populations of this species are isolated from one another. Within the exceptionally diverse Australian skinks, particularly *Ctenotus* spp., it has a unique distribution (Wilson & Swan 2021): restricted to a specific and fragmented natural habitat along the coast. The primarily coastal distribution of *C. angusticeps* suggests adaptation to salt marsh communities may have driven speciation from its ancestors, with the Airlie Island population secondarily adapting to the habitat now present on the island. Interestingly, the phylogenetic data suggests a relationship with *C. grandis* (e.g. Rabosky *et al.* 2007), a widespread species inhabiting spinifex deserts.
- It is a very highly specialised lizard inhabiting a harsh saline environment, subjected to extreme heat, wind, glare and tidal flooding. This environment is also additionally dynamic due to the ongoing effects of erosion on the decline or

expansion and re-establishment of mangroves into adjacent areas dependent on changing sea levels. Importantly, the mangroves are interconnected with the landward salt marsh communities and trap sand and sediment creating areas for samphire and other species to grow, thus forming the habitat of *C. angusticeps*.

- Only recently has a new marine park been established for the eastern and southern sections of the Exmouth Gulf, although final boundaries are yet to be determined. Some populations of *C. angusticeps* are known to occur in protected reserve systems on the mainland, such as the Yawaru Birragun Conservation Park near Broome and possibly the Jarrkunpungu Nature Reserve near Cape Keraudren. Outside protected areas, the known habitat of *C. angusticeps* is prone to development such as ports and salt ponds and destruction by 4WD vehicles and motorbikes, particularly in a large part of their known range around Karratha, Port Hedland and Broome. Trampling and vehicle use can cause long-term damage to habitats, especially to low-growing, succulent species and to smaller, more fragmented patches of salt marsh which can gradually lead to their degradation and loss. This damage to vegetation is evident at accessible locations on the Exmouth Gulf, where awareness and/or monitoring will be required as part of the management guidelines for the new marine park. Australia's mangroves and salt marsh communities are nationally recognised as ecologically important ecosystems (Commonwealth of Australia 2016). In southern Australia salt marsh communities are listed as nationally threatened with a ranking of vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). This vegetation type is also listed as a priority ecological community in southern WA (English 2013).
- A subjective approach can only be taken when estimating the area of occupancy (AOO) and extent of occurrence (EOO) based on what is perceived to be suitable habitat for a cryptic reptile species. In our opinion, this is even more difficult when considering the fragmented subpopulations of *C. angusticeps* due to its habitat specificity. Based on current knowledge of the combined population, the AOO: 72 km^2 and EOO: 34,972 km^2 are the estimated calculations for *C. angusticeps* (Chapple *et al.* 2019). The threatened species nomination form downgrading *C. angusticeps* (Department of Parks and Wildlife 2017) overstates the extent of potential habitat (tidal mud flat and mangrove) from Exmouth to the Northern Territory border: i.e. ~1750 linear km of coast. Consequently, the provided information perceives *C. angusticeps* to be present in all areas where coastal salt marsh communities exist. This is contrary to Maryan *et al.* (2013) who mention both Eighty Mile Beach area and Derby, where no *C. angusticeps* were detected, even though there are ample mangroves and tidal creeks margining the King Sound. Additionally, we have searched for this species in what appears to be suitable habitat around Onslow and Giralia Bay without success. As noted by Maryan *et al.* (2013),

we also observed *C. angusticeps* at locations on the Exmouth Gulf but only where crab holes of varying sizes were present in the salt marsh communities. Mangrove crabs are considered to be 'ecosystem engineers', a group of animals that physically create, maintain and modify their environment (Jones *et al.* 1994). Therefore, it is feasible to assume the spatial distribution and abundance of *C. angusticeps* that utilise these holes could be aligned with the distribution of particular species of crabs. We speculate further by suggesting there is minimal effective shelter where the *C. angusticeps* live apart from the crab holes and limited dense vegetation, so the crab holes could be an essential requirement for this species. We are not aware of any other Australian lizard habitually using crab holes to sustain it in areas subjected to periodic inundation.

Lastly, we reiterate the statements made by Maryan *et al.* (2013) of the unique ecology of *C. angusticeps* and how fascinating a field study may be of the relationship between this species and its environment, particularly how it may interact with resident crabs within their holes.

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Obituary

Marjorie (Margot) Rose Bentley

2 July 1927 – 29 September 2021

Which group within the Western Australian Naturalists' Club would have enjoyed tours of the Old Perth Fire Station Heritage Centre, the Desal Discovery Centre at Rockingham and Newspaper House in Osborne Park, walks at Wireless Hill and Lake Claremont, talks about Wedge-tailed Eagles and about early botanists, all in the same year? This was part of the programme for the Retired and Leisured (R&L) Group which had been organised by Margot Bentley for 2012. It was a typical list of activities whilst Margot was in charge (Fig. 1).

The R&L Group began in 1971. There were daytime meetings on alternate Wednesday mornings with talks and short excursions which were written up in the Naturalist News. Margot

Figure 1. Margot Bentley (L) and Lisa Kirkendale on a R&L Group visit to the WA Museum Mollusc collection, April 2012. Photo: Roz Hart.

took over running the R&L Group in 2007, following the sudden death of the previous convenor Doris Johnson, and continued in this role until 2017 when she stepped down because of failing health. She arranged an eclectic assortment of talks and visits, together with the opportunity for members to speak about something of special natural history interest to them. The meetings were held monthly on Wednesdays. The talks were in the morning in the Club office, excursions might be in the morning or afternoon. Margot always encouraged Club members to attend by speaking about the forthcoming meeting of the R&L Group at the monthly Main Club meeting. They were advertised in the Naturalist News and Margot always provided details of how to get to an excursion by public transport because she did not drive. She did not neglect the follow-up by always writing a brief report for the Naturalist News.

She was meticulous about setting up the Club office for the speaker meetings. She would arrive by taxi the previous afternoon to ensure that everything was set up correctly at the venue: were the projector and screen available for the next day? Were there sufficient chairs? If not, she would borrow them from other offices on the floor, and no one dared refuse.

On the day of the meeting, she would arrive early, providing a friendly welcome for all. Doug Hide said, 'The thing I remember most was how welcome I felt as a complete newbie. Not only to the group but to Nats. I was 66 so a late comer'. It all contributed to the R&L Group being recognised as a very friendly and inclusive part of the Club. Mind you, she was not a push-over, being a disciplinarian in relation to ensuring the speakers did not exceed their allocated time.

Margot's contribution to the R&L Group was recognised by being made an Honorary Life Member of the WA Naturalists' Club in 2014 (Fig. 2).

Figure 2. Margot Bentley when she was presented with Honorary Life membership of the WA Naturalists' Club by Roz Hart (President), 2014. Photo: Jolanda Keeble.

Margot Bentley was born in Perth. Her father, Dr James Bentley, was in charge of the Claremont Mental Hospital (Claremont Hospital for the Insane), a government-run facility that accommodated both children and adults with intellectual and other disabilities. The hospital was on a hill, surrounded by farmland and fresh air, and the Bentleys lived on site. She attended Methodist Ladies College in Claremont between 1934 to 1943 (Fig. 3) and was an assistant prefect in her final year.

Margot had a keen interest in natural history. She joined the WA Naturalists' Club in about 1947, at a time when the Club was undergoing a post-war revival under the presidency of Vincent Serventy. Meetings were held in the old Museum Lecture Room in Perth and there were monthly excursions to local areas of interest (Fig. 4). Her main interest was in plants, stimulated by the many beautiful trees in the grounds of the Claremont Mental Hospital. It would have been through the Club that she met the late Alan Notley in 1950, and they developed a life-long friendship.

In the early 1950s Margot left Perth for England where she studied librarianship, in between working in London and travelling widely in Europe. She returned to Perth in the late 1960s or early 1970s. From about 1972 Margot juggled two jobs: on Mondays, Tuesdays and Wednesdays she worked as an assistant librarian at Kinhill, an environmental engineering company, and then on Thursdays and Fridays she was a part-time librarian at the Department of Conservation and Environment, which later became the Environmental Protection Authority, in Perth. This arrangement continued until 1989 when she retired from the EPA.

On her return to Perth Margot re-joined the WA Naturalists' Club. She was a regular attendee at the monthly meetings of the Main Club which by this time, had moved from the cramped conditions at the Museum to the 'Naturalists' Hall', the new Club premises at Meriwa Street, Nedlands. She enjoyed the many excursions and was a member of the Bushwalking Group (Fig. 5).

Margot was a great supporter of the Australian Naturalists' Network,

Figure 3. The junior form at Methodist Ladies College in 1941. Margot is in the front row wearing a blazer. Photo: MLC archives.

Figure 4. WA Naturalists' Club trip to Garden Island, March 1951. Front: Val Reaves, Margot Bentley; back left to right: Dorothy Rowe, Malcolm Lacey, Vincent Serventy, Pat Rowe, Thema Russell, Peter Kneebone. Photo: Joy Harnett.

Figure 5. On a bush walk at Neerabup National Park, 16 June 1999. Left to right: not known, Margot Bentley, not known, Johanna Notley, not known, Sally Wilson, Gordon Elliott. Photo: Yvonne Doncaster.

and attended their Get-Togethers in Tasmania, Perth, the High Country, Chinchilla and Canberra. She enjoyed meeting new people, making friends from around Australia at these events.

From talking to her many friends Margot is remembered as a much-respected member of the Club. She had a retentive memory, recalling people and places who she had met and visited during her time in England, Europe and around Australia. She had very wide interests, enjoying music, theatre and the arts. She was cheerful, tactful but prepared to speak her mind if necessary. And as a person who was interested in plants, she had the most colourful garden in her street. She died peacefully at Alfred Carson Lodge.

Acknowledgements

I thank John Abbott, Michelle Campbell, Joy Dell, Yvonne Doncaster, Trudy Edmonds, Gordon Elliott, Maureen Gardner, Roz Hart, Doug Hide, Don Howe, Megan Keep and Johanna Notley for sharing their recollections of Margot.

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Obituary

Laurence George Fisher
3 January 1950 – 30 August 2021

Every club needs quiet members who are always willing to assist in any task. Larry Fisher was one of these. For a while he was the Club's property manager during the time of the Naturalists' Hall in Meriwa Street, Nedlands. The ceiling of the Naturalists' Hall (a former church hall) collapsed in the 1990s and he was one of a small band of volunteers who helped replace it.

Larry was the projector operator during meetings in the Naturalists' Hall and later when the Club meetings moved to the Hew Roberts Lecture Theatre at UWA and was able to fix any glitches that occurred. He was a member of Council during the 1970s, 80s and 90s.

Larry grew up in Perth. He was skilled cabinet maker working for a number of companies, and some of his commissioned works are in the WA Parliament and court buildings. He was also a skilled mechanic and enthusiastic motor cyclist.

He was intimately involved with the construction of the Club's Yunderup Nature Observatory on Culeenup Island in the Murray River Delta of the Peel Inlet. Otto Mueller (Club president from 1981–1983) was the organiser, Gordon Elliott (Club treasurer 1983–1985) looked after the money and Larry Fisher and other club members did the woodwork, painting, furnishing and electrical work. Construction was complicated because it was a kit house, and all the materials had to be ferried down river to the island on the Club's 12-foot aluminium dingy, the 'Lady Colebatch', from the jetty at Yunderup. On one occasion with Larry aboard, some of the materials fell off during the crossing and had to be rescued from the river. However, the building was completed and has served the Club for almost 40 years.

Figure 1. Larry Fisher. Photographer unknown.

Larry participated in the Club's Long-Range Expeditions to various parts of the State. For example, he went on the expedition to Lorna Glen and Carnarvon Ranges in August 1999 where he took part in the area's first flora and fauna surveys. He was part of the trip to Mt Elvira and Lake Barlee during Easter 2000. Then there was the week-long combined societies (WA Naturalists' Club, Birds Australia,

Figure 2. Larry Fisher. Photographer unknown.

Wildflower Society and Kimberley Society) Kimberley Camp Out at Kingston Rest with 87 others in July 2001. This was a fantastic seven-day event that he enjoyed immensely. Larry was a member of the excursion to Wongan Hills in November 2002 when, with 22 others, two days were spent getting to know the flora and seeing the spectacular display of verticordia at Reynoldson Reserve. At Meentheena Station on the Nullagine River in the eastern Pilbara Region in August 2004, where apart from many fascinating living and sub fossil life forms, we were shown several different forms of Stromatolites dating back 3.4 billion years. He was self-sufficient in a Subaru or 4x4 Lada Niva. He and others on these expeditions were well served by his mechanical skills.

Although Larry did not have expertise in any specific area of natural history, he was a keen photographer, always carrying a variety of equipment with him. He may have taken the recent portrait of himself.

Larry enjoyed the company of Club members and was always prepared to lend a hand, embodying the community spirit of the Club.

Gordon Elliott

Email: gordonius@iinet.net.au

Kevin Coate

Email: kevin.coate@bigpond.com

Obituary

Allen James Lowrie
10 October 1948 – 30 August 2021

Figure 1. Allen Lowrie aged 64. Photo: courtesy Lowrie family.

Allen James Lowrie, a member of the International Carnivorous Plant Society passed away on 30 August 2021, aged 72, after a short illness. He was a world authority on carnivorous plants, styleworts and triggerplants (Fig. 1). Born at Mount Hawthorn in Western Australia, he spent his early childhood in Mosman Park. His parents, Winnifred and Alan were in the fashion industry, which was probably an indication of where Allen's creativity and artistic flair came from. Growing up in Yokine, there were childhood memories of playing barefoot in the bush, making cubby houses and in teenage years riding bikes to hang-out at Lake Monger, where he made a canoe out of corrugated iron.

Beginning work at the age of 15, he forged a successful commercial career, turning his hand to advertising, steel fabrication, working as a geologist's assistant in the Pilbara, and eventually started a business constructing below-ground swimming pools. In 1970, Allen married long-time girlfriend Pauline See and daughters Trinity and Filicity soon followed (Fig. 2). Allen always acknowledged the part Pauline played in whatever he did. They were certainly a formidable couple when it came to exploring remote places. Pauline would be seen assisting Allen with his field work activities and helping to press and catalogue his numerous plant collections (Fig. 3).

Allen's philosophy on life was largely shaped by a close-call with compulsory enrolment for national service (or conscription) into Australia's armed forces during the unfortunate saga of

Figure 2. Allen Lowrie and Pauline See, in 1969, both aged 18, at the Economics Department Store, Perth, Annual Ball. Photo: courtesy Lowrie family.

Figure 3. Allen and Pauline Lowrie in 1993 conducting fieldwork in the Kimberley. Photo: Kevin Kenneally.

the Vietnam War (1962–1973). From an early age, it drove him to follow his great passion for botany, to be outgoing, to take risks, to profit from his own endeavours and to strive to succeed, but always having fun and adventures along the way. During his commercial career, he invented a range of pool chlorinators and pH controllers. The success of these inventions and his thriving business allowed him to leave the commercial world in 1987 to focus full-time on his studies of Australian carnivorous plants (*Aldrovandra*, *Byblis*, *Cephalotus*, *Drosera* and *Utricularia*), styleworts (*Levenhookia*) and triggerplants (*Stylidium*).

Australia is home to over one third of all carnivorous plant species that are currently known worldwide and this amazing concentration is far greater than in any other continent or country. Australia also boasts several endemic carnivorous plant genera that occur no-where else on earth. This became Allen's challenge: to collect and describe the many new species that awaited discovery. Though not formally trained in botany, Allen persevered in his research studies to become a truly accomplished botanist, working both solo and alongside mentors and colleagues in the plant sciences to make botanical pursuits his life's work. Even the great Charles Darwin wrote in a letter to Charles Lyell (24 November 1860): 'I care more about *Drosera* than the origin of all the species in the world' as he was attempting to finish a paper on carnivorous plants, such is the appeal of this intriguing group of plants. Darwin spent years drawing and experimenting, the results being published, around 1876, under the title *Insectivorous Plants*. Allen would tread a similar path.

In the mid 1970's, Dr Rica Erickson had approached Dr John Green, Curator of the Western Australian Herbarium, seeking a botanist to continue her work on carnivorous plants and triggerplants. Rica enjoyed plant collecting and describing new plant species (with Jim Willis, the Assistant Government Botanist for Victoria), their descriptions were accompanied by her very accurate drawings made from living specimens. She had published a series of books: *Orchids of the West* (1951), *Triggerplants* (1958) and *Plants of Prey in Australia* (1968). Dr Green was sympathetic to her request but pointed out that these groups were well-covered in her published books and a number of new triggerplants (*Stylidium*) had been published by American botanist Sherwin Carlquist. However, many other plant families were very poorly known in Western Australia and as such, required prioritising within the Herbarium's research program. He asked Kevin Kenneally if he was interested in curating the Herbarium's *Stylidium* collection, which Kevin agreed to do. In 1975, in company with his colleague Bruce Maslin from the

Western Australian Herbarium, they visited the major botanical institutions and gardens in Britain and Europe. This gave Kevin an opportunity to examine historical *Stylidium* collections from Western Australia, many of them 'types' (a specimen selected to serve as a reference point when a plant species is first named). In 1979, Kevin was again able to visit botanical institutions and examine historical plant collections in herbaria and botanical gardens world-wide, courtesy of a Churchill Memorial Fellowship. He now had a reasonable understanding of *Stylidium* in Western Australia.

Figure 4. Peter Taylor, a carnivorous plant specialist from the Royal Botanic Gardens, Kew at Cannington Swamp in 1979 to study and photograph *Byblis gigantea*. Photo: Kevin Kenneally.

Kevin Kenneally first met Allen in the late 1970s when he was researching plant material for his forthcoming volumes on carnivorous plants. This was the start of a lasting friendship and collaboration that would endure up to Allen's untimely passing. Allen had expressed an interest in *Stylidium* taxonomy and Kevin gave him his notes and photographs of historical plant collections held in herbaria in Australia and overseas. Kevin also referred him to Professor Sherwin Carlquist (1930–2021) and introduced him to Dr Rica Erickson (1908–2009). He also suggested Allen contact Peter Taylor (1926–2011), a botanist at the Royal Botanic Gardens, Kew, the world authority on bladderworts (*Utricularia*). Peter had published many papers and several books culminating in 1986 in his great taxonomic monograph on the bladderworts, *The Genus Utricularia*. Kevin had met Peter in 1975 when working at Kew. When he visited Perth in 1979, Kevin took him to Cannington Swamp (officially known as the Yule Brook Botany Reserve at Kenwick), where he photographed *Byblis gigantea* (Figs. 4 & 5). Allen would later name

Figure 5. The rainbow plant (*Byblis gigantea*) photographed at Cannington Swamp. Photo: Kevin Kenneally.

Utricularia petertaylorii in recognition of Peter's contribution to botany and for the assistance he had provided. He also noted that Peter began his world-wide study of *Utricularia* in 1948, the year Allen was born.

Allen forged a close relationship with Dr Rica Erickson, described by eminent botanist Dr Alex George as 'one the foremost amateur natural historians in Western Australia in the 20th Century'. Rica encouraged Allen to continue her studies of carnivorous plants and triggerplants (Fig. 6). Like Rica, Allen was an accomplished artist, drawing and photographing plants from living material, providing the many botanical drawings and illustrations for his books and papers (Fig. 7). He also built a series of glass and shade houses so that he could study plants and do long-term studies of their growth and flowering. He encouraged other carnivorous plant enthusiasts world-wide to experiment with cultivating Australian species, often with them producing outstanding results. He also established a successful business, supplying seeds and tubers that he cultivated at his home in Duncraig.

Figure 6. Allen Lowrie and Dr Rica Erickson discussing triggerplants. Photo: Kevin Kenneally.

Discovery in a highly synthetic field such as systematic/evolutionary botany involves multiple observations, rather than a concerted effort to elucidate a few facts by means of a definitive experiment as in many areas of experimental biology. Allen was a botanist really attuned to observing diversity, so much so, that it became a lifetime obsession. Allen maintained a private working collection of herbarium specimens for comparative taxonomic research. This saved him having to commute to the Western Australian Herbarium on a regular basis to compare material, although Allen did visit the herbarium and assisted with the curation of the *Drosera* specimens housed there. It was Allen's wish that his specimen collection, known as the '*Herbarium Lowrieanum*' be transferred to the Western Australian Herbarium on his death (Fig. 8).

Also encouraged by Rica's *Triggerplants* book was Professor Sherwin Carlquist, an American botanist, plant anatomist and photographer, who visited Western Australia in 1962 and found Rica's book in a Perth bookstore. He described the *Triggerplants* book as having 'the appealing charm that only someone genuinely enthusiastic about a hobby can confer'. Carlquist went onto describe many new Australian triggerplant species. In the late 1980s, Allen and Sherwin would collaborate in describing a new species of *Drosera* (Lowrie & Carlquist 1990), as well as a number of species of *Stylidium* (Carlquist & Lowrie 1989; Lowrie & Carlquist 1991). Carlquist described Allen as 'an amateur botanist whose enthusiasm was rather like that of Rica

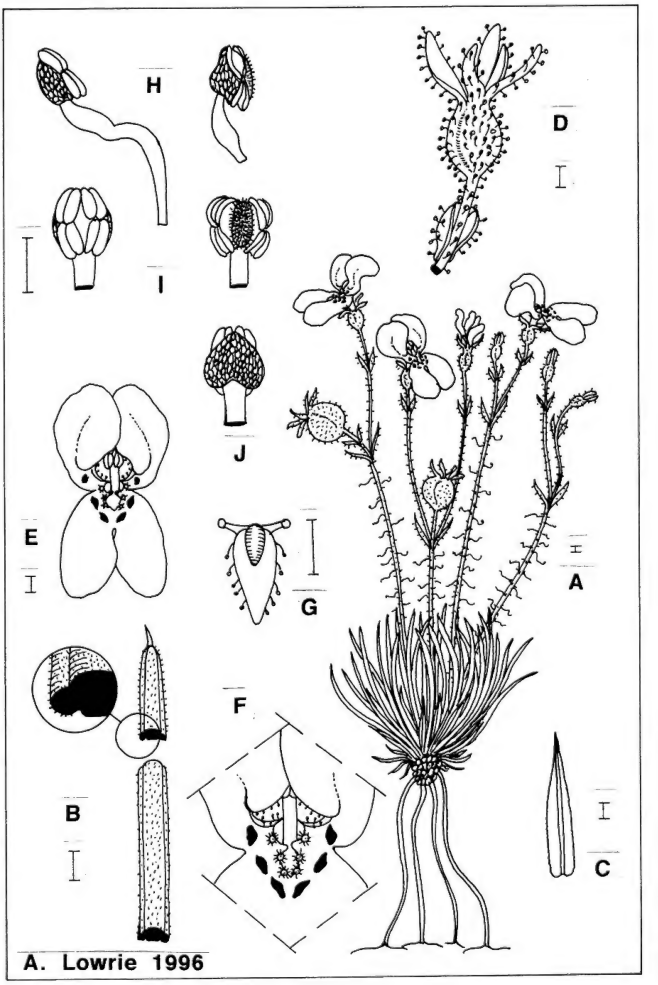

Figure 7. Allen Lowrie's drawing of *Stylidium paulineae*, a species he named in honour of his wife. Image: courtesy Lowrie family.

Erickson' (see Carlquist, In Memoriam, this volume).

Allen was also fortunate to be also mentored by Associate Professor Sidney (Sid) James, a cytogeneticist in the Botany Department at the University of Western Australia (Fig. 9). Sid had a passionate interest in the evolution of the Australian flora and was keen to encourage his students and individuals, like Allen, in their pursuits in this field. He conveyed to Allen the importance of understanding the variation existing in wild populations as being the key to sound taxonomy and an essential step in developing informed management for conservation. He also emphasised the need for scientific rigour, including the collection of adequate vouchers and documentation of study populations. Sid taught Allen how to do chromosome counts on *Drosera* and *Stylidium*.

Figure 8. A section of the *Herbarium Lowrieanum*, Allen's personal collection of dried and preserved herbarium specimens. Photo: Kevin Kenneally.

Armed with this information, Allen conducted botanical surveys across Australia, including Cape York Peninsula and the Kimberley, some of the most remote places in Australia (Fig. 10). He also made expeditions to Borneo and Sumatra, as well as Malaysia, with the assistance of Robert Oliver and Steve Rose to study *Nepenthes* - tropical pitcher plants (Fig. 11). Allen wrote that in Indonesia: 'We travelled from Padang to Lake Toba, exploring mountains and roadsides along the way. We were fortunate enough to join up with the *Nepenthes* study husband and wife team from Canada, John Turnbull and Anne Middleton. John had selected some great locations, the highlight of which was Mount Talang, Sumatra and Aia Batumbuak in West Sumatra. It was on this summit where we camped for the night. Just at dusk we heard the sound of a big cat. A tiger was in close proximity. We all slept with one eye open that night' (Lowrie 2016).

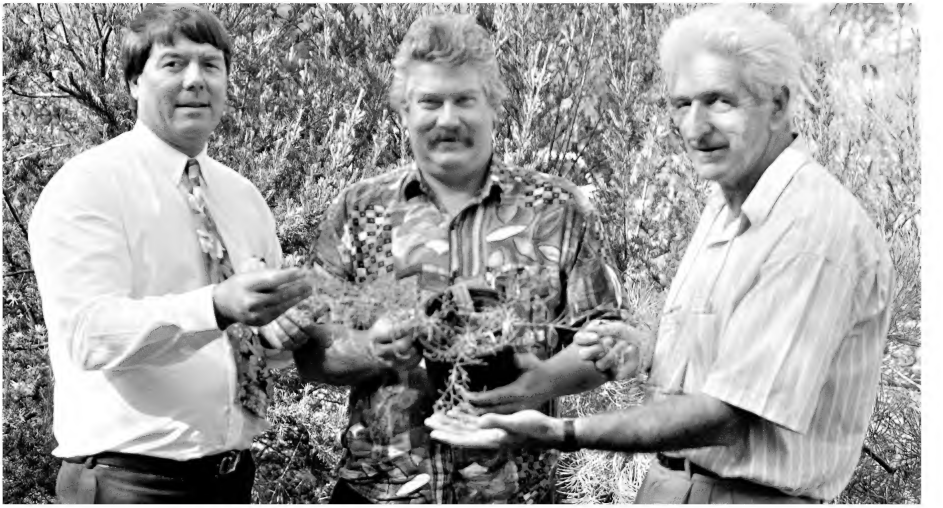

Figure 9. Kevin Kenneally, Allen Lowrie and Associate Professor Sid James, in 1992, examining a collection of the presumed extinct but re-discovered Merrall's triggerplant (*Stylidium merrallii*). Photo: Kevin Kenneally

Figure 10. Allen Lowrie collecting in the Kimberley in 1993. Photo: Kevin Kenneally.

Remote areas are not always welcoming. They are sometimes dangerous, but the worst part of fieldwork is the uncertainty of not finding what you are searching for. Allen would take his family on holidays to far flung places, but of course that always involved making plant collections of some description. Oh, and on any road trips, he never took food from home, not when you could buy sausage rolls and hot chips from servos (a petrol station) and road-houses along the way!

Between 1987 and 1998, Allen completed a three-volume treatise, *Carnivorous plants of Australia*, published by the University of Western Australia, documenting all Australian carnivorous plants known at that time. When the last book of the set was released in 1998, the three volumes had become the most highly respected,

Figure 11. Allen Lowrie in Borneo with a specimen of the painted pitcher plant (*Nepenthes burbidgeae*). Photo: courtesy Lowrie family.

most popular and certainly the most valuable of all carnivorous plant publications produced at that time. In 1992, Allen collaborated with Dr Neville Marchant from the Western Australian Herbarium in describing 34 taxa of Western Australian tuberous and pygmy *Drosera* species published in the prestigious Kew Bulletin (Marchant & Lowrie 1992). During the intervening 25 years since the publication of the original three volumes, Allen continued to undertake intensive field work and make observations, discovering many new Australian carnivorous plants. He carefully revised, updated and improved his original books and in 2013, his life's work was released in three volumes as *Carnivorous Plants of Australia Magnum Opus*.

During his botanical career Allen made 1,121 collections that are lodged in the Western Australian Herbarium (PERTH). He named 153 new taxa (*Drosera* 78, *Stylidium* 62, *Byblis* 7, *Utricularia* 4, *and Levenhookia* 1) and made a number of new combinations (*Drosera* 24 and *Stylidium* 3). His name is honoured in two carnivorous plant species *Drosera lowriei* (front cover), *Utricularia lowriei*, a triggerplant (*Stylidium lowrieanum*) and a smut fungus growing on *Byblis rorida* (*Yelsemia lowrieana*).

Aside from his many botanical achievements, Allen spent countless hours corresponding with carnivorous plant enthusiasts and scientists across the globe and was always happy to share his vast knowledge, especially eager to assist young beginners. He gave numerous lectures to botany students, wildflower enthusiasts, naturalist club members and the Kimberley Society, as well as contributing many scientific papers naming the many new species of plant that he has discovered. He was always happy to attend the WA Gould League's Bickley Science Camp School and enthralled the students with his living plant collection displays and his vivid descriptions on how they captured their prey. He also promoted the need to conserve carnivorous plant habitat. In an article in the Carnivorous Plant Newsletter in 1981, he wrote: 'What people don't realise is that most of the rare plants are confined to small scattered habitats all over Western Australia.'

In the early 1990s, Allen collaborated with Professor Kevin Kenneally and other botanists including Dr David Coates (Western Australian Herbarium) on a series of taxonomic papers describing new species of *Stylidium* (Figs 12–15). Allen also collaborated with Dr John Conran (The University of Adelaide) in describing new species of *Drosera* and *Byblis* and with brothers, Drs Matthew and Russell Barrett on new species of *Stylidium.*

Allen was a distinctive combination of blokes of his generation (often politically incorrect), but displayed intellectual substance, a high level of energy, natural combativeness (which could turn into a grudge) and a high-octane instinct for spotting new plant species. He called it as he saw it. There was no holding back. He had a wicked sense of humour that he shared around the campfire and a great belly-laugh. On a Landscope Expedition to the Mitchell Plateau in the Kimberley with Pauline in June 1993, he was asked to describe the flight of a Pheasant Coucal he had observed earlier in the day. When disturbed, these birds run erratically rather than fly, crashing into the vegetation as they take cover.

Figures 12–15. A selection of triggerplants (*Stylidium*) named by Allen lowrie and others. **(12)** *Stylidium aceratum,* **(13)** *Stylidium cilium,* **(14)** *Stylidium ireneae* and **(15)** *Stylidium pulviniforme*. Photos: courtesy Lowrie family.

Allen described the Pheasant Coucal as 'Having the aerodynamics of a Metters Oven!' It was on this trip he made the first Kimberley collection of the carnivorous water wheel (*Aldrovanda vesiculosa*) from a billabong above Mertens Falls.

On field trips his snoring was legendary and he was banished to the outer perimeter of the camp site. One night, his snoring was so loud, a female member of the party, who could not sleep due to the noise, walked over to him and shone a head-torch in his face, attempting to wake him up. Allen later re-counted that he awoke to a bright white tunnel of light and a face hovering over him. He was convinced he had died and was entering heaven! When he realised what was happening, he was not at all impressed at being woken!

Beyond his botanical pursuits, Allen was a loving husband, a doting father and grand-father, a keen musician, playing guitar, rhythm, lead and bass, the mandolin and keyboards. He wrote music for pleasure and composed and recorded no fewer than 30 songs. Prospecting for gold was another hobby that be enjoyed with some success, later becoming a partner with Steve Rose in a number of gold tenements in the Murchison District of Western Australia.

In the words of Sherwin Carlquist: 'Those who choose to do botanical work outdoors do so because they have that mindset, a willingness to sift through thousands of details and delight in doing so'. That was Allen's life. He made an enormous contribution, not only to Australian botany and conservation, but inspired many people to appreciate the joy of studying and cultivating carnivorous plants. He may have left us, but in the pantheon of Australian botany the name 'Lowrie' will be forever enshrined in the carnivorous and triggerplant literature. A complete list of Allen's publications can be found in the Carnivorous Plant Newsletter (Fleischmann 2022).

Acknowledgements

Kevin Kenneally thanks Pauline Lowrie and daughters Trinity and Filicity for providing memories and photographs of their husband and father. Julia Percy-Bower (Western Australian Herbarium) kindly provided information on Allen's plant collections held at PERTH.

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In Memoriam

Sherwin John Carlquist
7 July 1930 – 1 December 2021

Sherwin Carlquist was a Californian botanist, plant anatomist, artist and avid field collector who was recognised internationally for his lifetime work in science and the arts. Born in Los Angeles in 1930 he grew up admiring the living botanical collections at the nearby Huntington Library, Art Museum and Botanical Garden. In Australia, Sherwin will be remembered for his taxonomic studies in southwest Western Australia and in Arnhem Land in the Northern Territory on triggerplants (*Stylidium*) as well as his contribution to understanding the anatomy of vascular systems of Australian plants, particularly the resurrection plants *Borya* and *Platyzoma*.

Carlquist received his undergraduate degree from the University of California at Berkeley and a PhD in botany in 1956, also at Berkeley. He did a postdoctoral study at Harvard University from 1955 to 1956. After his postdoctoral studies, he began his teaching career at the Claremont Graduate School. In 1977 he also began teaching at Pomona College and continued teaching at both institutions until 1992. From 1984 to 1992, Carlquist was the resident plant anatomist at Rancho Santa Ana Botanic Gardens. His last post was as an adjunct

Figure 1. Sherwin Carlquist in July 1974, in the Blackstone Range (situated between the Western and Great Victorian Deserts) in Western Australia. Photo: Alex George.

professor at University of California at Berkeley from 1993 to 1998.

Upon his retirement, Sherwin returned to Santa Barbara. In 1992 Dr Edward (Ed) Schneider, the President and CEO of the Santa Barbara Botanic Gardens invited Sherwin to relocate his research laboratory to the Gardens. Ed had first met Sherwin in 1972 when he agreed to serve as an external member of his PhD committee. Here his anatomical studies using a scanning electron microscope, provided insights unavailable on the light microscope. It was during this retirement period that Sherwin undertook collaborative research projects with Allen Lowrie on Australian *Drosera* and *Stylidium* taxa (see Lowrie Obituary, this volume) and Ed Schneider and Kevin Kenneally on the vascular systems of Australian resurrection plants.

Sherwin was an avid field researcher and spent half a century travelling the world. This fieldwork was the beginning of his studies of how plants got to islands and how they changed after they arrived. He considered islands to be the 'laboratories of evolution'. His research led to three important books: *Island Life* (1965), *Hawaii: A natural history* (1970) and *Island Biology* (1974). Sherwin made important contributions to the field of island biology, studying particularly Hawaiian islands, introducing or emphasizing concepts such as island disharmony, loss of dispersal, increased woodiness and hybridization.

He studied wood anatomy, was an author of many plant taxa, including species of the carnivorous plant genus *Drosera*, the triggerplant genus *Stylidium* and the odd Western Australian genus *Alexgeorgea* whose female flowers are almost entirely underground.

Sherwin wrote at length about his fascination with Australian triggerplants and his travels (see www.sherwincarlquist.com.au):

'During my first visit to Western Australia, in 1962, I was attracted by the triggerplants, *Stylidium*, which have such a fascinating pollination mechanism.

'In a bookstore in Perth, I found Rica Erickson's wonderful little book, *Triggerplants*, published in 1958, which covered all the Stylidiaceae known at the time. Rica Erickson was an amateur who enjoyed collecting and very accurately drawing the species *Stylidium* and *Levenhookia*. The illustrations are very accurate, because they were done from living specimens. But in addition, the book has the appealing charm that only someone genuinely enthusiastic about a hobby can confer. It seems to invite one to identify and learn about the triggerplants of southwestern Australia-and indeed, they have speciated in spectacular fashion there.

'So, I accepted that invitation, as it were, and identified the species I found in 1962. In fact, I began to find some new species - especially in 1967 and again in 1974 (Carlquist 1976a). During my 1974 visit, I spent four months in Western Australia. I had not intended to spend that time in Western Australia, but botanist Alex George from the Western Australian Herbarium had invited me to join him, Kevin Richards an entomologist from WA Department of Agriculture and some other CSIRO staff in a trip to the central deserts of Australia, because the rainfall had been exceptional. I accepted, and the giant circle trip from Perth to Giles and back was a great adventure (Fig. 1). After the trip, I undertook field work in the southwest of WA. Larry de Buhr

joined me in order to collect materials for his Ph.D. thesis on *Drosera* while I collected – whatever. Larry sometime later described *Drosera marchantii* and *Drosera fimbriata* from this visit (de Buhr 1975). I, was enjoying my hobby of looking at Stylidiaceae of the region and seeing if I could discover some new species there.'

Of his discovery of *Alexgeorgea* he wrote:

'One morning, Larry and I were on the great sandplains in the Jurien Bay area, where I noticed here and there the green upright shoots of an inconspicuous plant I thought might be a restiad [a member of the plant family Restionaceae]. Further examination revealed male plants but no female plants until I spotted a group of three divergent purple threads emerging from the sand. I began to dig down. On older portions of the rhizomes, there were fruits, about the size and shape of acorns, sitting on the rhizomes (Fig. 2). The truly startling implication is that this plant evolved a method for bearing the fruits underground where they are least likely to experience damage from fire – and also escape predation' (Carlquist 1976b). He named this bizarre plant *Alexgeorgea,* in honour of Western Australian botanist Alex George, 'who had been kind to me during my travels in Western Australia'.

Meanwhile, Sherwin collected – whatever and enjoyed his hobby of looking at Stylidiaceae. He photographed the new species located in 1967, because he had improved his photographic techniques.

Sherwin pondered how so many new species of triggerplants could have been overlooked? The answer he wrote was very simple.

'Aside from Rica Erickson, nobody in recent time had been interested in them with respect to taxonomy. One must remember that Western Australia is a remote part of the world to most people and that in the 1960s and 1970s, few botanists worked there. Stylidiaceae are not conspicuous, and the large number of species probably tended to discourage most botanists from trying to identify them. However, there is some value in recording detailed photographic documentation of their features, which are interesting in themselves and is really better than a dried specimen in this group. The minute size of floral details and their delicate coloring make photographic documentation unusually valuable.'

Figure 2. *Alexgeorgea* a bizarre member of the Restionaceae family was named by Sherwin Carlquist and shows the subterranean acorn-sized fruit attached to the rhizome. Photo: Alex George.

In 1977, Sherwin visited Darwin on his way to Cairns, New Caledonia, Fiji, then home again. He wanted to become acquainted with tropical triggerplants (Carlquist 1978 & 1979). Sherwin applied for a grant from National Geographic Society and with the aid of a helicopter, explored the Arnhem Land sandstones. He was accompanied by a Northern Territory botanist, Clyde Dunlop, who provided camping supplies. Sherwin recorded: 'At the end of the third encampment, at the appointed time, the helicopter came into view and....flew right over us without stopping! A moment of panic. Clyde did something clever – he set fire to the dead leaves on some *Pandanus* trees. The helicopter saw the smoke and touched down. If I had any doubt about the merit of taking someone else along, it was erased when Clyde set fire to the Pandanus trees'.

After 1978, Sherwin never returned to Australia. He wrote 'The time there was so wonderful and productive, there was no point in more visits. I did, however, describe a few more *Stylidium* species. They were sent to me by Allen Lowrie, an amateur botanist whose enthusiasm was rather like that of Rica Erickson. He collaborated with me because I knew the apparatus for describing and publishing new species' (Fig. 3).

I first met Sherwin in 1996 at the Santa Barbara Botanic Garden. Our introduction was through Dr Schneider who was then Director and CEO of the Gardens. Ed and I had first met in the Kimberley in January 1982, when I invited him to participate in a biological survey of the Mitchell Plateau in the remote north Kimberley of Western Australia. Ed was then Dean of the College of Science at Texas State University at San Marcos, and had a long-standing research interest in the morphology of waterlilies (Nymphaeaceae). Of particular interest to him was the Kimberley endemic waterlily *Ondinea purpurea* (now *Nymphaea ondinea*), a species restricted to sandstone creeks in

Figure 3. The triggerplant *Stylidium carlquistii*, was named by Allen Lowrie to recognise Sherwin's outstanding contribution to Australian botany. Photo: courtesy of Lowrie family.

Figure 4. The Kimberley waterlily *Nymphaea ondinea* is endemic to sandstone creeks in the north Kimberley. Photo: Kevin Kenneally.

the north Kimberley (Fig. 4). As a result of Ed's visit to the Mitchell Plateau, flowering material was collected and a new subspecies described (Kenneally & Schneider 1983). Following on from the Kimberley fieldwork I visited Ed at Texas State University in 1990 and continued our research interest in Australian plants. In 1996, I visited Ed at the Santa Barbara Botanic Garden and was taken to meet Sherwin in his laboratory. Sherwin had fond memories of his time in Australia and though quiet and unassuming, I managed to get him outside of his laboratory for a photograph (Fig. 5). It was during my time at Santa Barbara that it was agreed that Ed, Sherwin and I would undertake anatomical studies of the vascular systems of the Australian resurrection plants (Figs 6 & 7), the endemic braid fern (*Platyzoma microphyllum*) and the pincushion plants (*Borya nitida*) from southwest Western Australia and *B. subulata* from the Kimberley (Carlquist *et al.* 1999, 2008). Studies of the pygmy

Figure 5. Sherwin Carlquist (left) and Kevin Kenneally at the Santa Barbara Botanic Gardens in 1996. Photo: Kevin Kenneally.

Figure 6. The tropical braid fern (*Platyzoma microphyllum*) endemic to northern Australia grows in sandy depressions and experiences marked fluctuations in water availability between the wet and dry seasons. Photo: Kevin Kenneally.

Figure 7. The pincushion plant (*Borya nitida*) photographed at Bickley Valley near Perth, grows on exposed granite outcrops, and on bare sands with low water-holding capacity and rapid drainage. Photo: Kevin Kenneally.

clubmoss (*Phylloglossum drummondii*) from southwest Western Australia were also undertaken to explore the ultrastructure of pit membranes in tracheids (Carlquist *et al.* 2012).

Sherwin Carlquist wrote 'I have enjoyed research just as much in retirement as I did before retirement'. The *Santa Barbara Independent* (Jan 04, 2022) recorded that he was 'admired for his scientific inquiry, intellectual curiosity, love of the natural world, artistic expression, scientific inquiry, meaningful connection, and leaving a legacy.

He taught so many to risk being an outsider, to think critically, access courage, and find enormity in the everyday. He modelled an impassioned independence and fierce, informed advocacy. He believed it was essential to choose things to care for, and know why they're worth it. His lifelong body of work will continue to speak for itself in both science and art, which is how he would have wanted it.'

I, for one, will miss his intellectual wisdom, his capacity and enthusiasm to share his science and lastly, my ongoing respect and admiration for his extensive years of meticulous field research.

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From Field and Study

Lake Forrestdale Cygnet Rescue

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Lake Forrestdale (32.1635°S 115.9379°E) is a typical example of a wetland in Western Australia impacted by a drying climate. The consequences of diminishing rainfall and government and private groundwater extraction are that the lake holds less water than in the past and dries up sooner than it ever did before.

The lake has always been a favoured site for nesting swans but in recent years problems arise when it dries before cygnets are old enough to fly. Moreover, once water in the lake falls below a certain level and conditions become unsuitable, adult swans fly to other wetlands for their own survival, leaving the cygnets behind. Without protection from the adults, defenceless cygnets quickly fall prey to foxes or die from exposure.

In September 2008, after witnessing this distressing situation year after year, Friends of Forrestdale approached the Department of Environment and Conservation (DEC), as it was then, with a view to conducting a cygnet rescue on the lake. The proposal was to catch the cygnets and relocate them to metropolitan wetlands that still had adequate water; cygnets too small to fend for themselves could be placed in care until ready for release.

The plan was agreed upon and the first cygnet rescue at Lake Forrestdale took place in January 2009. Over ninety DEC staff and volunteers conducted the operation, and thirteen cygnets were caught. The media was present, and several TV stations covered the event. In December the same year another rescue took place and since then a cygnet rescue at Lake Forrestdale has occurred most years.

Due to good rainfall over the 2021 winter and the lake being deeper than it has been for years, it was hoped the cygnets would be mature enough to fly before the lake dried up, obviating the need for a rescue. But that unfortunately was not the case. The extreme heat over Christmas and New Year and little rain since October meant the lake's water levels were dropping fast and an estimated 150 cygnets would need to be rescued.

Following discussion with Parks and Wildlife Service (PWS) and Friends of Forrestdale President David James, it was decided that the optimum date to conduct the rescue would be Friday 14 January—the water depth was low enough (130mm) to allow people ease of movement across the lake, but not so low that cygnets were starting to perish.

Word quickly went out and on the morning of January 14 over 200 individual and agency volunteers and PWS staff assembled at the lake's viewing platform at 5:15am ready for the muster. After an operational and

safety briefing, volunteers spread out around the lake (following advice by PWS, communicating with handheld radios) and formed a huge circle around the swans, calmly driving them into a dense flock towards a holding pen constructed for the purpose (Figs 1, 2, 3, 4).

Once the cygnets were contained in the holding pen, experienced volunteers went in and caught them and handed them to volunteers who took them to the triage team on the lake shore to be weighed, dewormed and crated. The operation went smoothly and efficiently and was over by 8.30am.

Figure 1. Volunteer rescuers heading out onto the lake. Photo: Bryony Fremlin.

Figure 2. Volunteers herding cygnets towards holding pen. Photo: Bryony Fremlin.

A total of 171 cygnets were rescued and of those old enough to be released, 33 were taken to Lake Joondalup and 31 to Lake Mealup. The remainder, still too young to fend for themselves, went to Darling Range Wildlife Shelter and Kanyana Wildlife Rehabilitation Centre.

Figure 3. Cygnets entering the holding pen. Photo: Bryony Fremlin.

Figure 4. Experienced wildlife handlers move in to catch the cygnets. Photo: Bryony Fremlin.

From Field and Study

Dioecy in *Tribulus suberosus* (Zygophyllaceae) and observations of pollination in related species

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The Zygophyllaceae is a small family of approximately 25 genera and 250 species of shrubs and herbs. There were four Australian genera *Nitraria*, *Roepera* (previously *Zygophyllum*), *Tribulopis* and *Tribulus* (which currently includes all species previously allocated to *Kallstroemia*) when revised by Barker (2013). Members of these genera are frequently found in halophytic habitats and/or arid regions. The family has been subject to considerable taxonomic study (Barker 1996, 1998a, 1998b, 2013) that has clarified generic and specific limits for all future studies. Notes on the presence of geocarpy in members of the tropical genus *Tribulopis* were discussed in Keighery (1982). However, little has been published on the ecology and biology of most species, possibly because of their remote location.

An exception is the detailed study in eastern Australia on the autecology of the long-lived shrub *Nitraria billardierei* (Noble & Whalley 1978a, 1978b). They found that populations are functionally dioecious, recording sex ratios of 1:2.3:0.5 female to male to hermaphrodite at Deniliquin (New South Wales) and 1:0.6:0.7 female to male to hermaphrodite at Lake Eyre (South Australia). However, this very distinctive genus of nine long-lived woody shrubs has been separated from the Zygophyllaceae as a separate family, the Nitrariaceae (Beirer *et al.* 2003), thus, leaving three genera in Australia, all from the tribe Zygophylleae.

During a biological survey of the Carnarvon Basin in 1994 at Woodleigh Station (26°13'08"S, 114°36'43"E) observations were made on a large population of *Tribulus suberosus* which determined that the population was composed of male and female plants in a sex ratio of approximately 1:1 (Table 1). The female plants were morphologically different from the males in being more slender with fewer main and side branches and only they bore fruit. Male flowers were much larger than female flowers and more strongly scented (Figs. 1, 2). Marked flowers remained open for several days. The readily accessed pollen and nectar was removed by a variety of flies, bees and wasps. In the warmth of the early evening the flowers were visited by small moths.

A second population of *T. suberosus* was subsequently scored near the Overlander Roadhouse (26°24'43"S, 114°27'10"E) in 2016. Here the population also consisted of male and female plants with sex ratio of

Figure 1. An open male *Tribulus suberosus* flower with 10 stamens. July near the Overlander Roadhouse, Carnarvon Basin, WA. Photo: Bronwen Keighery.

Figure 2. A mature female *Tribulus suberosus* flower with 10 reduced sterile stamens. July near the Overlander Roadhouse, Carnarvon Basin, WA. Photo: Bronwen Keighery.

approximately 1:1. Other populations at Yardie Creek (22°17'23"S, 113°54'32"E), Minilya (23°49'29"S, 114°36'55"E) and Tom Price (22°41'21"S, 117°47'51"E) were scored during other biological surveys. All populations consisted of male and female plants (Table 1).

We have examined the 158 collections of *T. suberosus* in the Western Australian Herbarium (PERTH) and found that 18 were sterile (lacking flowers or fruit), and of the remaining 140, 98 had mature fruits. This left 42 informative collections of which 13 had only female flowers and 25 only male flowers. There were three collections that had separate pieces of plant stems containing male or female flowers (there was no indication if these flowers came from the same or separate plants). We are confident that the evidence shows that *T. suberosus* is normally dioecious.

There are two shrubby species of *Tribulus* (*T. platypterus* and *T. suberosus*) that are confined to Western Australia, and both form large, even-aged populations after disturbance, e.g. fires or floods. Our examination of 66 (56 in flower) collections of *T. platypterus* in the Western Australian

Table 1. Sex ratios of field populations of the species *Tribulus suberosus.*

Locality	Male Plants	Female Plants	Not Flowering
Woodleigh Station	22	18	2
Overlander Roadhouse	24	19	2
Yardie Creek	13	11	5
Minilya	27	21	2
Tom Price airfield	37	28	6

Herbarium together with several wild populations in the Pilbara suggests that all populations of this species have hermaphrodite flowers. This species is a slender, smaller version of *T. suberosus* and may be quite short lived, but field observations are lacking. Only one herbarium collection (Gibson 0002, PERTH 04363523) had a branch with both female and male flowers. This collection had many intermediate vegetative features between *T. playpterus* and *T. suberosus* and came from Peak Hill in the Pilbara, a highly disturbed mine revegetation site where both species occur.

In her review of dioecy in the flora of South-western Australia McComb (1966) lists all three genera and nine species of Zygophyllaceae (including *Nitraria*) present in this area as having hermaphrodite flowers. Similarly, Barker (1996, 1998a, 1998b, 2013) found no evidence of obviously dioecious species in herbarium collections of the family Zygophyllaceae. Neither did Lawrence (1992) when discussing the genera *Tribulopis*, *Tribulus* and *Zygophyllum* in tropical Western Australia. This is may be because of the similarity of flowers of the two sexes in insect pollinated species, which are difficult to see in herbarium material, rather than the very different flowers consisting of anthers or stigmas seen in wind pollinated species, e.g. Casuarinas and Jointed Rushes. This is especially true for succulent leaved plants, as we have documented similar cases of dioecy in Western Australian members of the genus *Carpobrotus* (Aizoaceae) where it was previously unrecorded (Keighery & Keighery 2019).

Dioecy is relatively rare in flowering plants (about 15,000 species of *c.* 260,000, Renner & Ricketts 1995), but very widespread. It is thought that this is because dioecy can be rapidly acquired and lost, with few genetic changes required (Bawa 2003). This could be the case in the Zygophyllaceae where all members of the family in Australia have simple, single, open yellow flowers that are insect pollinated by nectar/pollen collecting bees, wasps and flies.

We have also made observations on seed set and pollination in other members of the family from all genera present in Western Australia. We were able to obtain data on nine of the 20 species of *Roepera* from the field and/or cultivation during the biological survey of the eastern goldfields and in cultivation at Kings Park. Five species with small, inconspicuous flowers (*R. compressa, R. iodocarpa, R. ovata, R. similis* and *R. tetraptera*) are rarely visited by pollinators in the field, but set very high number of fruits when allowed to self-pollinate in cultivation. These species normally co-occur with large flowered, mainly outbreeding annual species, such as *R. glauca*, which are visited by a variety of insect pollinators although also able to self-pollinate in cultivation. Four widespread perennial species of *Roepera* (*R. aurantiaca, R. billardierei, R. eremaea* and *R. fruticulosa*) also have large open pollinated flowers, although they are also able to self-pollinate in cultivation.

Tribulus has 16 species in Western Australia consisting of largely annual herbs, most of which have large, colourful yellow flowers that are accessible and visited by bees and wasps. In cultivation, three native species (*T. astrocarpus, T. cistoides* and *T. macrocarpus*) were self-fertile on closure of isolated flowers. A possible exception is *T. hirsutus*, which in

cultivation has male, female and hermaphrodite flowers on the same plant, but this needs confirmation from field observations. The only largely self-pollinating small flowered annual species is the weed *T. terrestris*, however, further studies are needed.

Tribulopis is a tropical genus of seven species of annual herbs. Some species such as *T. angustifolia* contain both small flowered inbreeding populations (Mitchell Plateau) and large flowered outbreeding populations (Broome), as determined from observation of both field and cultivated material. All cultivated species (*T. angustifolia*, *T. bicolor* and *T. pentandra*) are self-fertile but have large open pollinated flowers. In the field flowers are visited by a wide range of bees, flies and wasps.

Our studies of all members of the Zygophyllaceae cultivated at Kings Park (genera *Roepera*, *Tribulopis* and *Tribulus*) are self-fertile, although those with conspicuous flowers are generally protandrous and apparently adapted for both self- and cross-pollination. We speculate that the widespread nature of self-fertility in the family, especially in annuals, may have been an evolutionary spur to the adoption of dioecy to promote outbreeding, by excluding self-pollination in the longer-lived shrubby members of the family. This appears to be a common feature of the condition for perennials as having half the population producing only outbreed seed does not reduce overall lifetime seed production but increases genetic variability (Muyle *et al.* 2021).

In conclusion, our observations of *Tribulus suberosus* from the Carnarvon Basin are the first confirmed record of dioecy in the family Zygophyllaceae in Australia and are a common feature of this species. All other species of *Roepera*, *Tribulopis* or *Tribulus* (with the possible exception of *T. hirsutus*) have normal hermaphrodite flowers in any living population or herbarium collections examined (Barker 2013; G Keighery, pers. obs.).

Acknowledgements

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One of us (GJK) was able to access, observe and study many species grown by the horticultural staff in the collections in Kings Park Nursery, where he was the biosystematist from 1974 to 1984.

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From Field and Study

Amphibians and reptiles of a small semi-rural lot in Darlington, Western Australia

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The first record of the Crowned Snake (*Elapognathus coronatus*) from the lateritic plateau of the Darling Range east of Perth, was reported by Maryan and Algaba (2011). Because this is a common species further south, they considered this as indicative of the paucity of faunal surveys in the area.

The historical impact of urbanisation on the ground vertebrate fauna of the Perth region, including the northern Darling Range, has been studied in great detail (How & Dell 2000; Report to Australian Heritage Commission Canberra 2003). These accounts detail the herpetofauna from 10 sites in the northern Darling Range, from Julimar and Bindoon, south to Canning Dam. Several of the sites reviewed by How and Dell (2000) in the Darling Range lie on the Pinjarra Plain at the junction of the coastal plain and the Darling escarpment. Similar detailed faunal studies have been carried out at the Worsley Aluminium mine (Dames & Moore 1981; Worsley Alumina 1985), and other unpublished reports have been commissioned by Worsley Alumina that contribute to a knowledge of the Darling Range herpetofauna (Bamford *et al.*2004; Ninox Wildlife Consulting 1998, 2002, 2003).

The following list of frogs and reptiles recorded here lists data for another site in the northern Darling Range. It is from Lot 8 (number 50) Dalry Road, Darlington (31°54'54"S, 116°04'53"E), where I lived from 1980–2005. While there was no formal trapping, the general maintenance of the property over such a long period of time, I am confident about the near completeness of the list and relative abundance of the 16 species recorded. The two notable absentees from the list are the Western Beared Dragon (*Pogona minor minor*) and skinks of the genus *Lerista*.

The triangular site (0.2 ha) is on the corner of Dalry Road and Neilsen Crescent on the north edge of Helena Valley. The block falls away steeply over about 100 m (229 m at Dalry Rd to 211 m at the bottom of Neilsen Crescent). Surrounding residential lots are up to about 1 ha Binbrook Reserve (Reserve 1847) 100 m to the east is just over 7 ha in area and contiguous with the Railway Reserve that runs all the way from Boya at the edge of the escarpment to Mundaring.

Because of the "open plan" of the surrounding residential lots, limited fencing and the proximity of reserves, it is reasonable to view the following list as representative of the general area rather than just Lot 8. I include one record from a neighbour's garden.

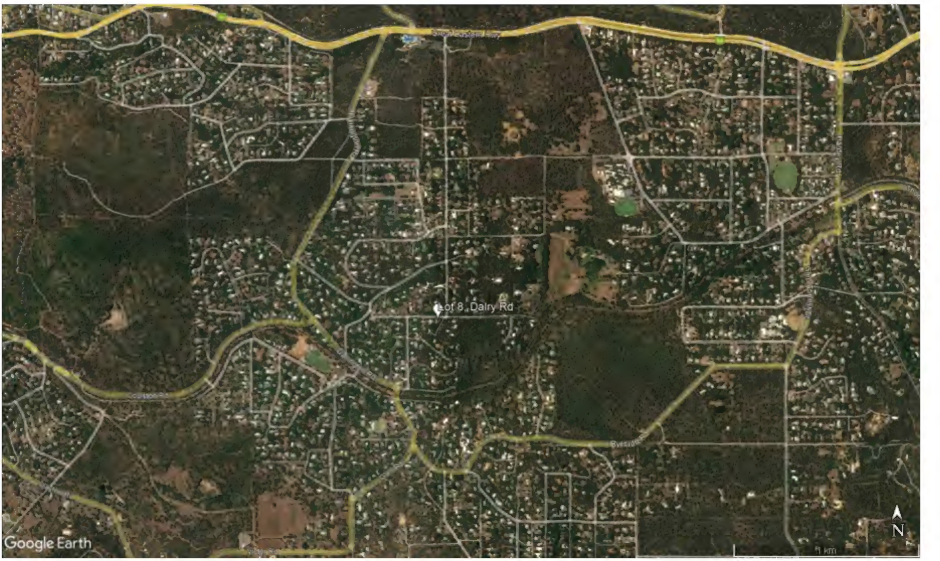

Figure 1. Location of Lot 8 in Darlington, Western Australia.

The natural terrain is laterite but about the top 50% of the block is taken up with the dwelling (built *circa* 1960), terraced gardens and buildings. The remainder is an open canopy of Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia* calophylla) over *Xanthorhoea* spp. and a few fruit trees. The ground is bare and gravelly with little ground cover. What there was of the native ground cover (Red and Green Kangaroo Paws *Anigozanthus* sp.), Fringed Lillies (*Thysanotus* spp.), Flannel Flower (*Actinotus leucocephalus*), Pin Cushions (*Borya sphaerocephala*), Trigger plants (*Stylidium* spp.) and Blue Leschenaultia (*Leschenaultia biloba*) on the lot slowly disappeared to be overrun by *Watsonia marginata*, *Chasmanthe floribunda* and other weeds.

Common names are from Bush *et al.* (2007).

Amphibians

Limnodynastidae

Heleioporus barycragus (Hooting Frog)

Recorded twice. One specimen found under a pile of wet rotting leaves in winter. Lot 8 is about 300 m from Nyaandia Creek, adjacent to the Railway Reserve Trail.

Pelodryadidae

Litoria adelaidensis (Slender Tree Frog)

Not recorded on Lot 8 but regularly heard calling from artificial ponds from a neighbour's garden about 100 m north.

Litoria moorei (Motorbike Frog)

Recorded once in natural circumstances (specimen in a fern garden) but Motorbike Frogs bred in great numbers

in the early summer of 1980 when the property was vacant and swimming pool maintenance was neglected.

Reptiles

Geckos

Carphodactylidae

Underwoodisaurus milii (Barking Gecko)

Moderately common under laterite boulders, fallen branches and stacked timber. Sometimes indoors.

Diplodactylidae

Strophurus spinigerus spinigerus (Southwestern Spiny-tailed Gecko)

Uncommon. Not more than about 10 found.

Gekkonidae

Christinus marmoratus (Marbled Gecko)

Found in similar circumstances to *U. milli*. Often indoors.

Pygopodidae

Lialis burtonis (Burton's Legless Lizard)

Rare. Only recorded in 1993.

Skinks

Scincidae

Acritoscincus trilineatus (Southwestern Cool Skink)

Rare. Recorded once.

Cryptoblepharus buchananii (Southwestern Snake-eyed Skink)

Common on trees and walls.

Ctenotus labillardieri (Red-legged Ctenotus)

Rare. Only a few records. The nearest preferred habitat for this species (exfoliating granite is several hundred metres away at the top of Montrose Avenue).

Hemiergis initialis initialis (Southern Five-toed Mulch Skink)

Apart from *Cryptoblepharus*, this species was the most common reptile on the lot. Mostly under laterite.

Morethia obscura (Shrubland Pale-flecked Morethia)

Rare. Only a few records.

Menetia greyii (Common Dwarf Skink)

Very rare. Not recorded until 1993.

Tiliqua rugosa rugosa (Bobtail)

A resident "family" always present as neonates and subadults occasionally seen.

Goannas

Varanidae

Varanus tristis (Racehorse Goanna)

One record. A subadult in the house. This species described and often reported by neighbours.

Snakes

Typhlopidae

Anilios australis (Southwestern Blindsnake)

Uncommon. A few collected (overnight casualties of a swimming pool).

Elapidae

Pseudonaja affinis affinis (Dugite)

Adults, subadults and neonates encountered regularly but not often.

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